ELECTRICAL STUD-WELDING APPARATUS WITH WORKPIECE ACTUATED CONTROL MEANS

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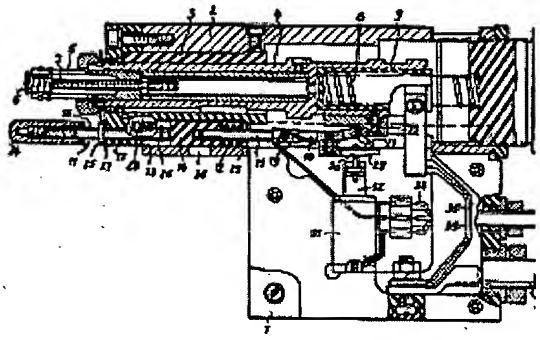
Electrical stud-welding apparatus of greater efficiency and reliability and more simply operated than known stud-welding apparatus. A base member is provided with a tubular housing, an insulating bushing therewithin and a welding piston inwardly of but of greater length than the bushing. Mounted in the housing is an actuating member under the control of a coil compression spring comprising a rod capped on its forward end on the workpiece side of the apparatus. Means including an electrical control circuit actuate the longitudinally moving parts.



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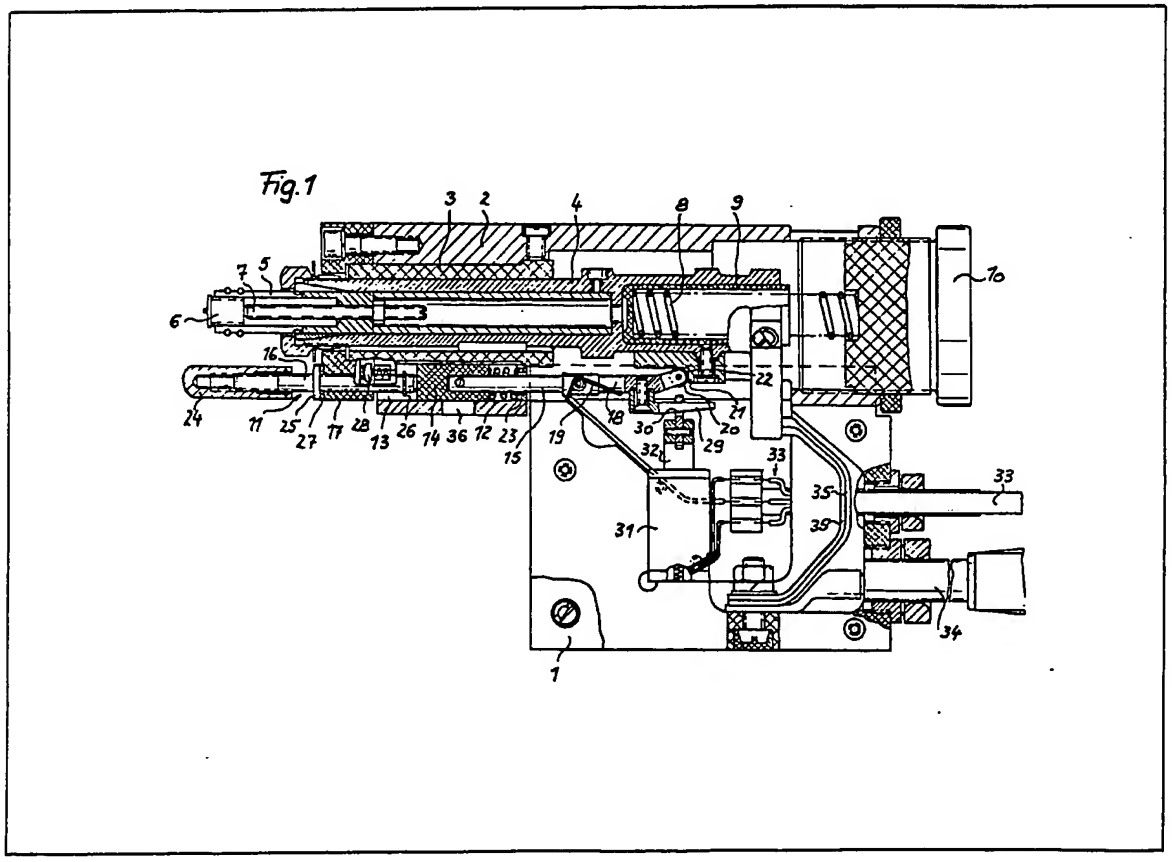
(54) Electrical stud-welding apparatus with workpiece actuated control means

(57) An electrical stud-welding apparatus comprises a welding plunger (4) adjustable axially in the housing (2), a stud holder (5), projecting beyond the front end of housing (2), being provided at one end of the welding plunger (4), a spring (8) acting on the other end of the plunger, and an actuating member (11), by means of which the welding plunger (4) can be moved into its rear end position when the actuating member (11) engages the workpiece. When cap 24 on member 11 engages a workpiece, rod 15 causes the roller 20 of a spring-biassed pawl 18 to engage flange 22 on plunger 4 which is thus moved against spring 8, and contacts 27, 28 on member 11 cause a voltage to be applied to electromagnetic tripping device 31 which maintains the roller 20 against flange 22 by retaining means 32, 30, 29, thus holding plunger 4 in its rear position. Only when the stud is correctly positioned, is the device 31 tripped to release roller 20 and hence plunger 4 to effect the stud-weld.



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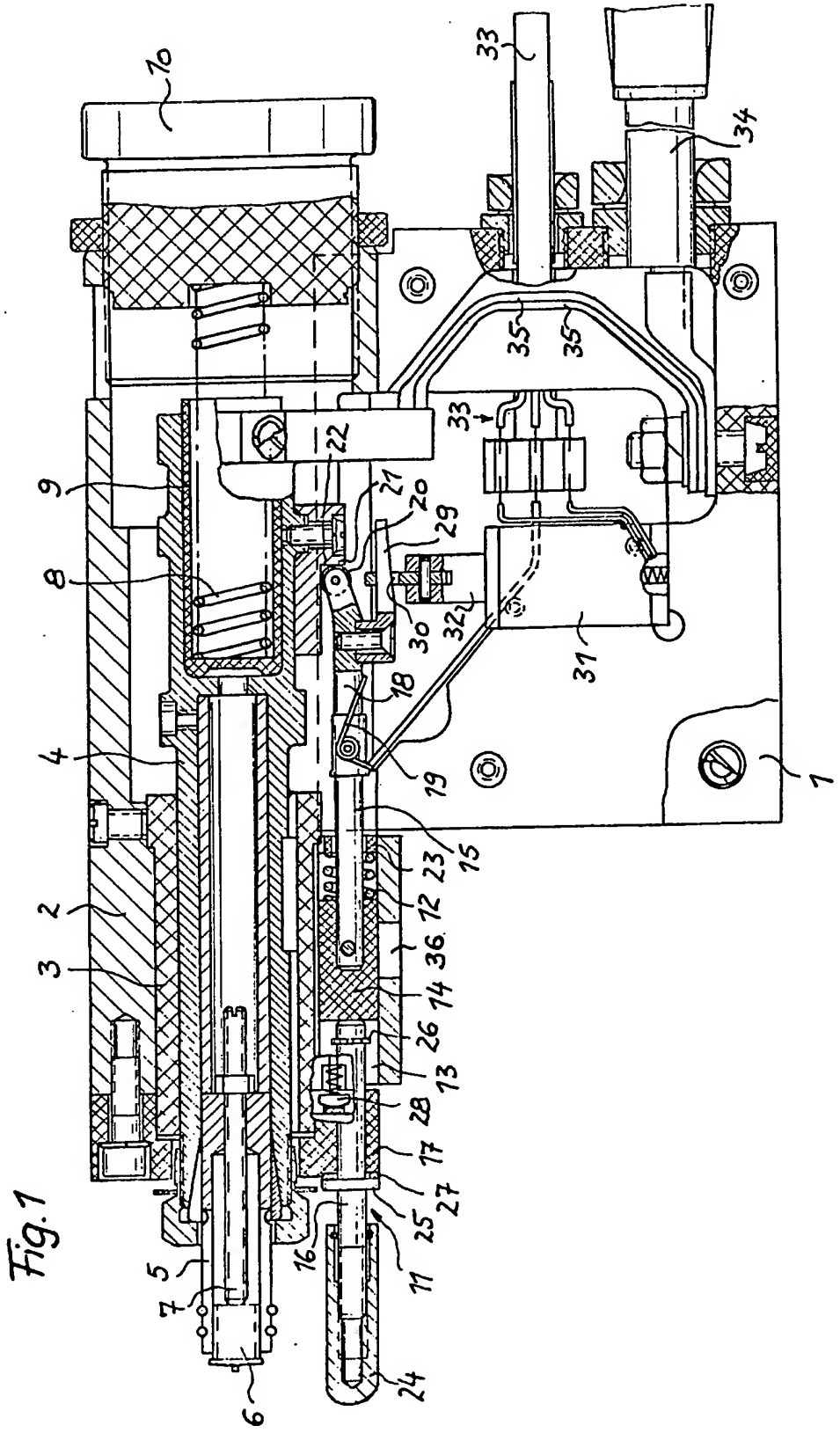

Fig. 1

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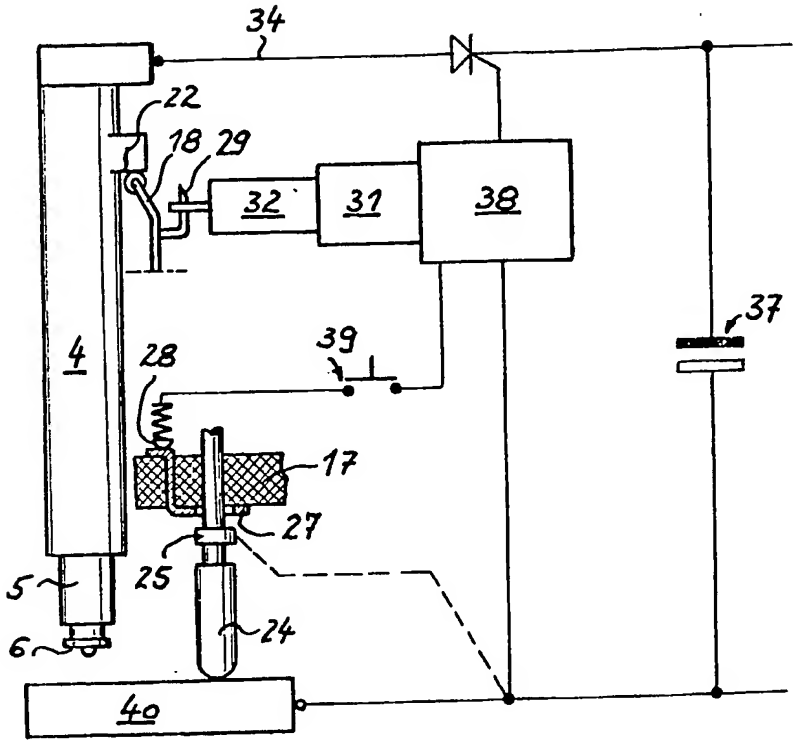
Fig.2



SPECIFICATION

Electrical stud-welding appartus

The invention relates to an electrical stud-welding apparatus.

In a stud-welding apparatus which is known from German Patent Specification 2,516,407 and on which the invention is based, an actuating part is articulated, within the apparatus housing, to a manually actuable tripping grip at one of its ends, whilst the other end of the actuating part is held in contact against the welding plunger in such a way that, when the tripping grip is actuated, the welding plunger, together with the stud holder and a welding stud inserted therein, is brought approximately into the working position against the force of the spring and, when the tripping grip is actuated further, the welding plunger is released and is pressed forwards for carrying out the welding by the welding plunger.

However, even after only a small number of welding operations carried out in rapid succession, this actuating device acting like a pistol trigger leads to signs of considerable fatigue in the finger actuating the trigger. In addition, there is, here, the danger that the apparatus will be tripped, that is to say, the welding operation started, even before the welding apparatus is correctly positioned against the workpiece to which a stud is to be welded. Also, during the tripping, there is the danger of a change in position of the previously correctly positioned apparatus.

Moreover, known stud-welding apparatus of this type which work on the capacitor discharge principle, have the disadvanage that, as a result of wear on the mechanical controls acting in response to the welding-circuit switch, the capacitor discharge takes place ahead of or lags behind the moment of impact of the stud on the workpiece in an ever changing manner.

It is an object of the present invention to provide a stud-welding apparatus which has increased operating reliability, and simpler and more convenient handling than that obtained with previously known devices.

According to the present invention there is provided an electrical stud-welding apparatus comprising a housing, a welding plunger mounted within the housing so as to be movable axially relative to the housing to a limited degree, between a front end position and a rear end position, a stud holder being provided at the end of the plunger adjacent the front end of the housing, which holder projects beyond the said front end of the housing, energy storage means comprising a spring element urging against the other end of the plunger, and an actuating member, said actuating member being operable to move the welding plunger towards its rear end position against the force of the spring element and being further operable to retain the plunger in its rear end position until the welding operation is started, wherein the actuating member is adapted to be supportable on the workpiece surface such that, when the housing is brought towards the workpiece, the welding plunger is moved automatically into its rear end position, in which position it is ready for welding.

This has the advantage that both hands can be used for bringing back the welding plunger and for tensioning the very powerful spring element acting on the welding plunger, in such a way that the apparatus supported against the workpiece can be brought into the position of readiness simply by moving the apparatus towards the workpiece, resulting in substantially simpler handling than hitherto obtained.

Furthermore, the apparatus according to the invention is less likely to be tripped prematurely, especially before it has been brought into the welding position.

In a prefered embodiment of the present invention the actuating member comprises a rod which is mounted so as to be movable parallel to the axis of the welding plunger to a limited degree between a front end position and a rear end position and which, in the front end position, projects beyond the stud holder when a stud is inserted therein.

This design is favourable from a production point of view and is also particularly efficient.

For further simplification of the handling of the apparatus, it is advantageous if an energy storage means is provided which urges the actuating member towards its front end position.

As a result, the actuating member is returned automatically into the starting position after each stud-welding operation. It is therefore unnecesary to move the actuating member into the starting position by hand. In this respect, preferably the energy storage means for the actuating member comprises a helical compression spring which compression spring is attached to the actuating member, said actuating member having a shoulder, the compression spring being prestressed and disposed to act between the said shoulder of the actuating member and the housing.

Preferably, for coupling the actuating member releasably to the welding plunger, a pawl is connected on the actuating member, said pawl being controlled by a tripping device and which, in the front end position of the actuating member engages positively in a catch provided on the welding plunger.

Advantageously, to further reduce wear on the apparatus, the pawl may be provided with, at its free end, a rotatably mounted supporting roller and preferably the portion of the catch against which the pawl is supported when in its engaged position is flat and directed substantially perpendicular to the longi-

tudinal axis of the welding plunger.

For further increasing the operating reliability of the apparatus described above, advantageously contact elements are provided on the actuating member and on the housing, the actuating member being electrically insulated from the welding plunger and the housing, said contact elements being arranged so that, when the actuating member is in its rear end position, they cause the welding circuit to close.

These measures ensure that the welding circuit can be closed only when the apparatus has been brought into a correct position relative to the workpiece. Advantageously at least one of the contacts is supported frictionally, biased against the other contact. As a result, the apparatus head can be exchanged without difficulty for another apparatus head adapted to the respective workpiece and/or material, without the trouble of having to detach and reconnect the electrical lead.

In a further advantageous development the effective length of the actuating member is adjustable.

This makes it possible to adapt exactly to the respective requirements the holding distance of the stud to be welded from the workpiece before the apparatus is tripped, for varying the acceleration and, consequently, the impact velocity of the stud on the workpiece after the apparatus has been tripped.

In this respect, advantageously, over the free end part of the actuating member there is provided a cap, which cap is adjustable and lockable along the length of the actuating member.

Furthermore, advantageously, for correctly positioning the apparatus against the workpiece to which a stud is to be welded, a spacer member is provided on the free end of the actuating member, said spacer member having a plurality of supporting points located adajcent one another at the same level.

An advantageous development for further simplifying the handling and for increasing operating reliability lies in the provision of an electrical tripping device which is preferably arranged to become electrically effective in response to a welding-current switch, such that the tripping device and the welding-current switch act synchronously.

As a result, a substantially constant synchronisation of the switching actions is achieved.

Advantageously, for controlling the pawl acting on the welding plunger by means of the electrical tripping device, the electrical tripping device has an adjustment element movable substantially perpendicular to the longitudinal axis of the welding plunger and ending in an eyelet, a finger, which is on the pawl connected to the actuating member and which points substantially in the direction of displacement of the actuating member, passing through the eyelet of the adjustment element and being movable in the direction of displacement of the actuating member.

A specific embodiment of the invention is now described by way of example only and with reference to the accompanying drawings, in which:

Figure 1 shows an electrical stud welding apparatus, in longitudinal section;

Figure 2 shows a circuit diagram of the apparatus shown in Fig. 1.

In this electrical stud-welding apparatus which is designed to be used on a production line, a tubular housing 2 is fastened to a base part 1.

Retained in this housing is an insulation bush 3 in which a welding plunger 4 made of electrically conductive material is mounted so as to be adjustable coaxially to the housing 2 to a limited degree.

At the front end, the welding plunger 4 carries a stud holder 5 in which is inserted a welding stud 6 which is supported in an axial direction against an adjustable stop pin 7. Acting on the other end part of the welding plunger 4 is a helical compression spring 8 which is supported, at one end, on the welding plunger 4 via an insulation bush 9 and, at the other end on a set screw 10 which is located coaxially in the housing 2 and by means of which the prestress of the spring 8 can be set.

Also provided is a rod-like actuating member 11, by means of which the welding plunger 4 can be adjusted against the force of the spring 8. The actuating member 11 projects beyond the housing 2 on the workpiece side and is mounted in this housing so as to be adjustable to a limited degree parallel to the axis of the welding plunger 4, against the force of a restoring spring 12.

The actuating member 11 consists of a piston 14 made of insulating material, guided in a bore 13 of the housing 2, comprising a first rod 15 and a second rod 16.

The rods 15 and 16 are arranged coaxially to one another, the rod 16 being mounted in a bore of an end plate 17 made of insulating material, which is fastened to the housing 2.

Articulated on the rod 15 is a pawl 18 which is pressed against the welding plunger 4 by means of a leg spring 19. The pawl 18 carries at its free end a roller 20 which corresponds to a catch 21 which is located on the welding plunger 4 and of which the flat flank 22 facing the roller 20 is directed at right angles to the longitudinal axis of the welding plunger.

Retained on the rod 15 is the helical compression spring 12 which is prestressed, and disposed to act between the piston 14 and, via an insulation ring 23, the housing 2.

The rod 16 carries at its free end part a screwed-on cap 24.

Also located on the rod 16 are a collar 25

and a spring ring 26 which limit the axial adjustability of the rod 16 supported on the plunger 14 by means of the rearward end part.

The axial adjustability of the actuating member 11 corresponds at least to the axial adjustability of the welding plunger 4.

Furthermore, a pair of contact elements 27, 28 is provided in the housing, and these are arranged to interact with the collar 25 so that the control circuit is closed only when the actuating member 11 is in the rearward end position.

Fastened to the pawl 18 is a finger 29 which, when the pawl 18 is engaged, is directed parallel to the axis of the actuating member 11.

This finger 29 passes through an eyelet 30 which is fastened to the free end of an adjustment element 32 which can be actuated by an electrical magnetic tripping device 31.

The tripping device 31 is located in the base part 1 and can be actuated by means of a switch not shown in Fig. 1.

A control lead 33 influencing the welding circuit leads to a tripping device 31.

Also provided is a welding-current supply lead 34 which is connected to the welding plunger 4 via electrically flexible strip-shaped leads 35.

The tripping device 31 acting on the pawl 18 is connected electrically so that, when its circuit is closed to release the pawl 18, whereupon the adjustment element 32 displaces the finger 29, according to the drawing, downwards until the pawl 18 releases the welding plunger 4, the welding circuit is also closed.

Instead of the base part 1 for which adjustment elements (not shown) are provided for displacing the apparatus in the longitudinal direction of the welding plunger 4, it is also possible to provide a handle which is directed transversely to the longitudinal axis of the housing and in which the same individual parts as in the base part 1 are arranged.

To bring the apparatus into the position of readiness for welding, it is first brought, mechanically or by hand, near to the workpiece to which the stud 6 is to be welded, so that the actuating member 11 is supported against the workpiece by means of its cap 24.

When the apparatus housing 2 is brought even nearer to the workpiece, the actuating member 11 the pawl 18 of which is arranged so that it can engage into the catch 21 when both the actuating member 11 and the welding plunger 4 are in their front end positions, is pushed into the apparatus housing.

During this time, the welding plunger 4 is driven into its rear end position due to the action of the pawl 18 and the catch 21 and the spring 8 is simultaneously further prestressed.

When the rear end position of the actuating member 11 has been reached, the contacts 27, 28 close an electrical control circuit which causes an electrical voltage to be applied to the electromagnetic tripping device 31, in such a way that the latter cannot act on the pawl 18 until the apparatus has been brought into the correct position relative to the workpiece.

After a, for example, manually actuable switch controlling the tripping device 31 has been actuated, an electrical voltage is applied to the tripping device 31 after which the adjustment element 32 is moved downwards electromagnetically and carries with it the pawl 18 via the eyelet 30 and the finger 29, whereupon the welding plunger 4 springs forwards as a result of the force of the spring 8 and presses the stud 6 onto the workpiece.

When the tripping device 31 is switched on, an on-off switch of the welding circuit is, at the same time, switched, under the influence of an electrical control not shown in Fig. 1, in such a way that a capacitor discharge takes place during the impact of the stud 6 on the workpiece.

Instead of the cap 24, it is also possible to provide on the rod 16 a spacer (not shown) having, for example, three feet, so that it is adjustable in the axial direction of the rod 16, and by means of this spacer not only can the particular distance required between the stud 6 and the workpiece, when in the position of readiness for welding shown in the drawing, be fixed, but the apparatus is also automatically aligned correctly with the workpiece when all three feet located at a radial distance from the axis of the welding plunger are supported against the workpiece. This is necessary especially in the case of hand-held apparatus, whilst in the case of stationary apparatus as shown in the figures, a rod shaped spacer is sufficient to determine the position of the apparatus.

The cap 24 can also consist of electrically conductive wear-resistant material, for example, beryllium-copper, and can be connected to the welding-current lead, so as to apply the welding–current earth lead to the workpiece via the cap 24, as is represented by broken lines in Fig. 2.

A window 36 with a marking is provided opposite the piston 14 in the housing 2 and a scale, which coincides with the marking and which can be read off through the window is provided in the plunger 14, and the respective preselected distance (air gap) between the stud 6 held in the position of readiness for welding and the workpiece can be read off on this scale.

As a result, there is no need to measure the air gap by means of a feeler gauge.

Furthermore, Fig. 2 shows an electrical capacitor 37, the above-described electrical control 38 and a manually actuable switch 39 designed as a button and located in the

control lead.

40 designates a workpiece to which the stud 6 retained in the apparatus is to be welded.

CLAIMS

1. An electrical stud-welding apparatus comprising a housing, a welding plunger mounted within the housing so as to be movable axially relative to the housing to a limited degree, between a front end position and a rear end position, a stud holder being provided at the end of the plunger adjacent the front end of the housing, which holder projects beyond the said front end of the housing, energy storage means comprising a spring element urging against the other end of the plunger, and an actuating member, said actuating member being operable to move the welding plunger towards its rear end position against the force of the spring element and being further operable to retain the plunger in its rear end position, until the welding operation is started, wherein the actuating member is adapted to be supportable on the workpiece surface such that, when the housing is brought towards the workpiece, the welding plunger is moved automatically into its rear end position, in which position it is ready for welding.

2. A stud-welding apparatus according to Claim 1, wherein the actuating member comprises a rod which is mounted so as to be movable parallel to the axis of the welding plunger to a limited degree, between a front end position and a rear end position, and which, in its front end position, projects beyond the stud holder when a stud is inserted therein.

3. A stud-welding apparatus according to Claim 2, wherein an energy storage means is provided which urges the actuating member towards its front end position.

4. A stud-welding apparatus according to Claim 3, wherein the energy storage means for the actuating member comprises a helical compression spring, which compression spring is attached to the actuating member, said actuating member having a shoulder, the compression spring being prestressed and disposed to act between the said shoulder of the actuating member and the housing.

5. A stud-welding apparatus according to anyone of Claims 2 to 4, wherein a pawl is connected on the actuating member, said pawl being controlled by a tripping device and which, in the front end position of the actuating member, engages positively in a catch provided on the welding plunger.

6. A stud-welding apparatus according to Claim 5, wherein the pawl is provided with, at its free end, a rotatably mounted supporting roller.

7. A stud-welding apparatus according to Claims 5 or 6, wherein the portion of the catch against which the pawl is supported when in its engaged position is substantially flat and directed substantially parallel to the longitudinal axis of the welding plunger.

8. A stud-welding apparatus according to any of Claims 2 to 7, wherein contact elements are provided on the actuating member and on the housing, the actuating member being electrically insulated from the welding plunger and the housing, said contact elements being arranged so that, when the actuating member is in its rear end position, they cause the welding circuit to close.

9. A stud-welding apparatus according to Claim 8, wherein at least one of the contacts is supported frictionally, biased against the other contact.

10. A stud-welding apparatus according to anyone of the preceding claims, wherein the effective length of the actuating member is adjustable.

11. A stud-welding apparatus according to Claim 10, wherein over the free end part of the actuating member there is provided a cap, which cap is adjustable and lockable along the length of the actuating member.

12. A stud-welding apparatus according to Claim 10, wherein a spacer member is provided on the free end of the actuating member, said spacer member having a plurality of supporting points located adjacent one another at the same level.

13. A stud-welding apparatus according to anyone of the preceding claims, further comprising an electrical tripping device.

14. A stud-welding apparatus according to Claim 13, wherein the elctrical tripping device is arranged to become electrically effective in response to a welding-circuit switch, such that the tripping device and the welding-circuit switch act synchronously.

15. A stud-welding apparatus according to Claim 13 or Claim 14, wherein the electrical tripping device has an adjustment element movable substantially perpendicular to the longitudinal axis of the welding plunger and ending in an eyelet, a finger, which is on the pawl connected to the actuating member and which points substantially in the direction of displacement of the actuating member, passing through the eyelet of the adjustment element and being movable in the direction of displacement of the actuating member.

16. An electrical stud-welding apparatus substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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